The Journal of Foot & Ankle Surgery 56 (2017) 943–948

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Navicular Stress Fracture Outcomes in Athletes: Analysis of 62 Injuries

Amol Saxena, DPM, FACFAS [1], Shontal A. Behan, BS [2], Dallas L. Valerio, BA [2], Dominick L. Frosch, PhD [3,4]

[1] Podiatrist, Department of Sports Medicine, PAMF-Sutter, Palo Alto, CA
[2] Student, California School of Podiatric Medicine, Oakland, CA
[3] Adjunct Associate Professor, Department of Medicine, University of California at Los Angeles, Los Angeles, CA
[4] Senior Scientist, PAMFRI, Palo Alto, CA

ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
athletics
elite
runner
sport
stress fracture

ABSTRACT

The optimal treatment modalities for navicular stress fractures in athletes is currently unknown for this season-ending injury. The present study evaluated factors that might be significant and affect healing outcomes, specifically focusing on the return to activity (RTA) time and a decreased desired activity (DDA) after treatment in athletes. Such considerations included previous navicular stress fractures, patient demographic data and type of sport, and initiation time of treatment. The data from 59 patients with 62 fractures were prospectively analyzed from May 2005 through July 2016. The results showed a significant correlation between a previous navicular stress fracture and decreased desired activity. The average duration of symptoms before receiving definitive treatment was 8.8 months. Computed tomography as the initial imaging modality correlated positively with a correct diagnosis (1.00). In contrast, magnetic resonance imaging, when used initially, was only 71% accurate. Runners constituted most of the cohort at 38 (61.3%). Ten other athletes were involved in jumping sports. Of the 62 injuries, 21 (33.9%) were in elite or professional athletes, all of whom were able to RTA, with 1 patient, a 38-year-old world record holding runner, having a DDA. Seven refractures (11.2%) occurred an average >5 years after the initial injury, predominantly in those aged <21 years, none with previous surgery. Eight patients (12.9%) developed postinjury arthrosis, including 1 with DDA. Patients who underwent open reduction and internal fixation had a RTA of 4.56 months compared with those who had undergone nonoperative treatment, who had an average RTA of 3.97 months. Seven patients (11.2%) underwent screw removal and required a longer RTA. Overall, of the 62 injuries, the patients with 57 of the injuries (91.9%) were able to RTA at their preinjury level.

Navicular stress fractures (NSFs) are rare in the general population; however, they appear more prevalent in athletes, in particular, those engaged in rigorous sprints or jumping (1–3). Although the pathomechanics remain unclear, some have speculated that foot type and microtrauma are common causes (1–5). NSFs account for approximately one third of all stress fractures of the lower extremities (1,6,7), albeit these injuries can be difficult to diagnose secondary to vague complaints and a high occurrence of false-negative results on radiographs (1,3,4,7–11). The most consistent symptom presented by patients is dorsal midfoot/anterior ankle pain, ranging from soreness, cramping, to sharp pain, extending to the arch, that is exacerbated with sprinting activities (4,11,12). Little bruising and swelling will be present, likely owing to the lack of blood supply of the navicular. This could also be the reason the injury is difficult to recognize (2–7,11). Suspicion should be increased when pain is reproduced with palpation to the "N" spot, the most dorsal aspect of the talonavicular joint (4,7,13). Because of the high incidence of false-negative results on plain radiographs, bone scans, magnetic resonance imaging (MRI), and computed tomography (CT) scans have been accepted as imaging options; however, some studies have recommended CT scans as the superior modality (10,11,14).

The best primary treatment, conservative versus surgical, of NSFs has become a topic of debate. Some studies have reported that conservative (i.e., nonoperative, non-weightbearing management) will lead to the most successful outcomes, independent of the fracture type or interval to the onset of treatment (15). However, Saxena et al (4) found that the healing time paralleled the fracture severity and consequently created a classification system that reflected the different degrees of fracture that correlated with the outcomes and healing times (Table 1) (16). To achieve similar and consistent healing

Financial Disclosure: None reported.
Conflict of Interest: None reported.
Address correspondence to: Amol Saxena, DPM, FACFAS, Palo Alto Medical Foundation, 795 El Camino Real, Clark Building, Level 3, Palo Alto, CA 94301.
E-mail address: heysax@aol.com (A. Saxena).

1067-2516/$ - see front matter © 2017 by the American College of Foot and Ankle Surgeons. All rights reserved.
http://dx.doi.org/10.1053/j.jfas.2017.06.009

Table 1
Navicular stress fracture classification

Type	Description
0.5	Stress reaction; signal change on MRI noted, but stress fracture not imaged on CT
I	Dorsal cortical fracture on coronal image
2	Fracture extends into navicular body on coronal image
3	Complete propagation of fracture to second cortex (medial, lateral or plantar) on coronal image

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging.
Adapted from Saxena et al (4) and Saxena and Fullem (16).

times, they determined that surgery for more severe NSFs would yield more predictable outcomes. Using their classification system, below-the-knee casting or boot and immobilization were found to be acceptable when treating type 0.5 and type 1 NSFs. However, surgical treatment (i.e., open reduction and internal fixation [ORIF]) was recommended as the first-line treatment for athletes with type 2 and 3 NSFs, especially those with cystic changes, sclerosis, or osteonecrosis (3,10,11,13,17). Surgery should be strongly considered owing to the frequency of delayed union and refracture, which, in return, results in unpredictable healing times (4,5,11,12,17–20). A shorter return to activity (RTA) is imperative for athletes and is often the determining factor when deciding on treatment recommendations. Although all studies, conservative and surgical, have defined outcomes as the interval required to return to activity or play, some surgical studies have included long-term outcomes, recognizing a greater incidence of refracture in patients only treated nonoperatively (3,4,13).

The optimal treatment modalities for NSFs have not yet been determined. The main factors discussed regarding NSF outcomes have been whether nonoperative or surgical treatment should be the first line of treatment. However, other factors should also evaluated because these can be significant and can affect the results. Such considerations include previous NSF fractures, patient demographic data, and type of sport, because significant differences could exist in the RTA among certain athletes or cohorts. Furthermore, a delay in diagnosis can result in malunion and arthrosis (13); thus, the interval to the initiation of treatment could affect one's ability to obtain an asymptomatic foot or a reasonable time to RTA. We sought to evaluate whether a delayed or wrong diagnosis is a significant factor and occurs secondary to false-negative results from imaging studies. Our study was conducted to evaluate the possible influences and determine whether they significantly affect NSF outcomes. The purpose of the present study was not to determine the etiology and biomechanical factors of NSFs, because these have been previously studied (4,7,11,12,20).

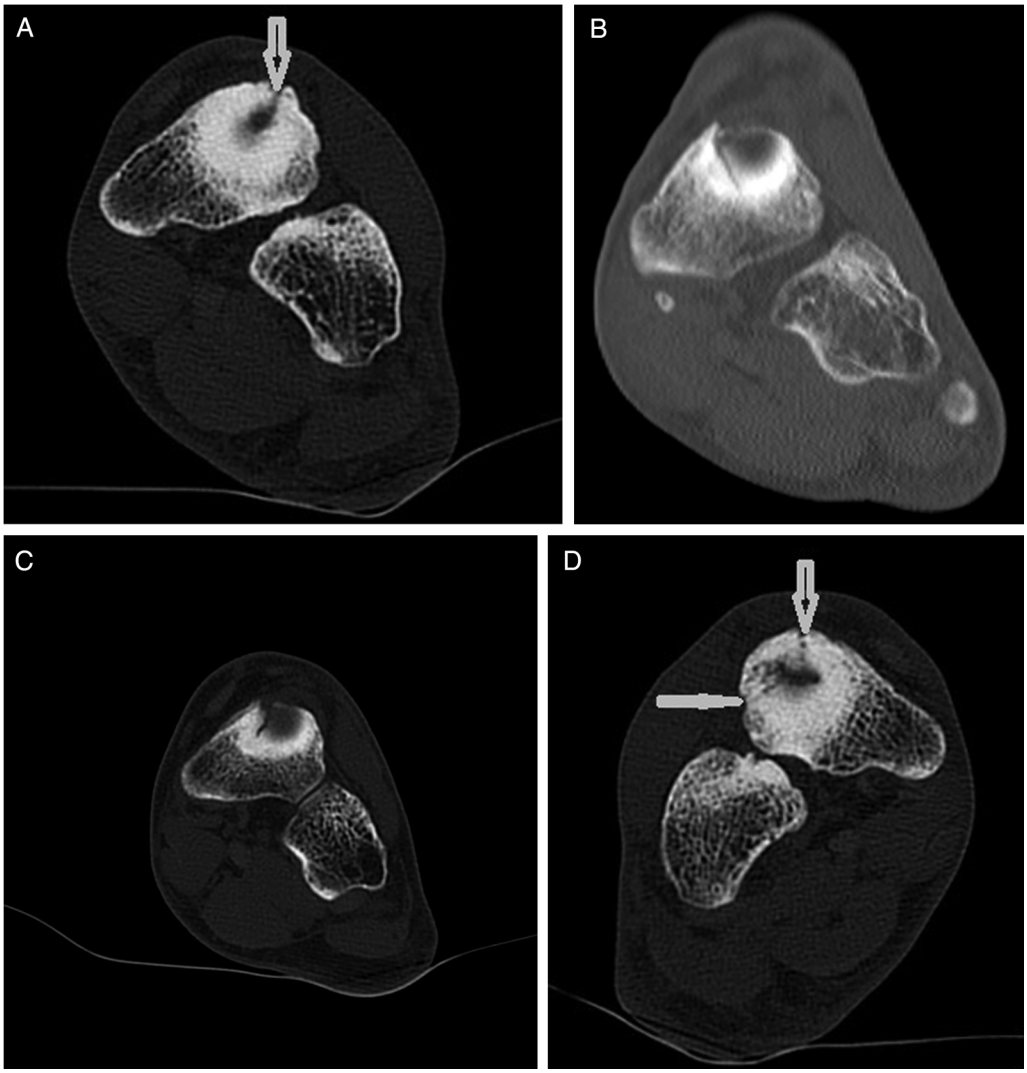

Fig. 1. (*A*) Type 1 navicular stress fracture (NSF), with a dorsal cortical break. (*B*) Type 2 NSF with a more typical appearance. The screw orientation should be from laterally to medially. (*C*) Type 2 NSF with a less common fracture pattern. The screw should be from medially to laterally. (*D*) Type 3 NSF, with a complete cortical break.